

Volume 21

Study G-III-D

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

POPULATION STUDIES OF GAME FISH AND
EVALUATION OF MANAGED LAKES IN
THE UPPER COOK INLET DRAINAGE

by

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RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations
of Alaska

Project No.: F-9-12

Study No.: G-III Study Title: LAKE AND STREAM INVESTIGATIONS

Job No.: G-III-D Job Title: Population Studies of Game
Fish and Evaluation of
Managed Lakes in the Upper
Cook Inlet Drainage

Period Covered: July 1, 1979 to June 30, 1980

ABSTRACT

A strain of native Alaska rainbow trout, Salmo gairdneri Richardson, from Swanson River has been selected as hatchery brood stock for Alaska's fry and fingerling lake stocking program. The Swanson strain was chosen over two other rainbow trout brood stock candidates, the Talarik Creek, Alaska, strain and the Alaska-produced Ennis, Montana strain, because of consistently better survival in field and hatchery situations. Population estimates in 1979 indicate overall Swanson survivals were almost two times greater than Talarik survivals, and approximately 70 times greater than Ennis survivals.

Examination of fish biomass in five Matanuska-Susitna Valley lakes reveals a significant correlation between morphoedaphic index values and the pounds of fish produced per surface acre for rainbow trout stocked in 1978.

Habitat studies in Johnson Lake indicate rainbow trout fingerling, planted at a single release site, took 2 days to disperse completely around the perimeter of the lake. Studies also indicate stocked fingerlings utilized only areas of the lake less than 16 feet deep during their first 8 months of lake residency.

Growth rates and mean lengths and weights of several age classes of Swanson strain rainbow trout are presented.

Sampling bias between gill nets and fyke nets, and fyke nets and minnow traps for catches of rainbow trout are discussed.

A comparison of Peterson and Schnabel methods for estimating population size indicates the Schnabel method can be as efficient and is more desirable than the Peterson method when estimating numbers of harvestable size Age I Swanson strain rainbow trout.

BACKGROUND

Alaska's lake stocking program makes an important contribution to recreational fisheries within the State, but does not always produce desired results. A high cost to the creel often occurs due to poor game fish survival which, in turn, reduces recreational fishing opportunity.

A lake study project designed to provide information for the development of improved stocking practices was initiated in 1973. This study has focused on selected lakes of the Matanuska-Susitna Valleys and is based on identification and analysis of various limnological parameters and their effects on fish populations.

The early phase of this project concentrated on detailed collection of physical and chemical data and identification and relative quantification of various planktonic and invertebrate populations in untreated lakes and in treated lakes prior to, during and after chemical rehabilitation with rotenone. Findings from the initial investigative phase indicate: (1) a morphoedaphic index (MEI, or specific conductance divided by mean depth) can give a gross measure of relative potential productivity and, in most cases, is easier to determine than statistically comparable plankton, periphyton, chlorophyll a indices or definitive water chemistry (Chlupach, 1977); (2) lakes chemically treated with rotenone may require between 1 and 2 years to reestablish zooplankton production and 3 years to attain invertebrate production levels of previous dominance and abundance (Chlupach, 1977); and (3) a chemical test for the determination of rotenone in water (Post, 1955) can give a reasonably accurate measurement of residual rotenone concentrations of ± 0.2 ppm and can be used to detect the presence of rotenone in concentrations at or below 0.2 ppm (Kalb, 1974).

The second phase of this project has concentrated on determining stocked game fish survival and growth in lakes of known limnological characteristics, some of which contain competitor or predator species or both. Findings from this research segment show: (1) potential growth of rainbow trout may be restricted in waters infested with stickleback (Kalb, 1975); (2) rainbow trout survival appears to be greater in waters where stickleback have been eradicated than in waters where these competitors are present, although in a stickleback environment, fish survival increases when relatively larger fish are stocked at lower densities (Chlupach, 1978); and (3) coho salmon in landlocked lakes exhibit significantly greater survival than do domestic rainbow trout strains (Chlupach, 1978).

Another phase of the lake study program involved the selection of rainbow trout brood stock. Prior to 1974, rainbow trout eggs from Ennis, Montana and Winthrop, Washington supported Alaska's trout culture program. Because both strains have extensive domestic histories, a feature that may cause them to be vulnerable to Alaska's environmental conditions, and because of the risk of possible importation of disease organisms, a decision was made to develop and evaluate Alaskan brood stocks.

The Swanson River on the Kenai Peninsula, and the Naknek River and Talarik Creek in Bristol Bay were selected as sites for egg takes which were initiated in 1974. Bristol Bay trout were chosen primarily for their large size and long life span, whereas the Kenai fish were selected because of a lake

rearing background and a possible greater tolerance to stickleback competition. The Naknek strain, taken only in 1974, was rejected for further use because of difficulties in procuring wild spawners and because existing brood facilities could not accomodate three segregated native Alaskan strains. Eggs were again taken from rainbow trout at Swanson River and Talarik Creek in 1975 and 1976 to build up necessary brood age classes and to provide fingerlings for immediate research stocking needs. Eggs were taken once more at Swanson River in 1979 to develop a sound genetic base for use as a brood stock.

Rainbow trout eggs from Ennis, Montana and Winthrop, Washington continued to be imported through 1975, and the last rainbow trout eggs to enter Alaska were imported from Willamette, Oregon in 1976 to fulfill lake stocking needs at that time.

The third rainbow trout strain chosen as a candidate for Alaska's brood stock program was the Alaska-produced Ennis strain. The Ennis rainbow trout were chosen for evaluation because (1) the strain features December spawning which permits early summer fingerling stocking; (2) early liberation of Ennis trout also vacates hatchery space required for rearing native Alaska fry produced from spring spawning Swanson and Talarik stocks; and (3) the Ennis strain's extensive cultural background accomodated comparative studies between native Alaska and domestic brood programs.

The first Ennis fingerlings from Alaska brood stocks were planted in 1975, while the initial Swanson and Talarik fingerlings from hatchery brood stocks were stocked in 1977 and 1978, respectively.

Field evaluation of the Swanson, Talarik and Ennis strains is based on comparative gill net catches and catch rates, population estimates and relative lengths and weights in a wide range of lake types both with and without competitor species.

Gill net catch rates for individual stockings of native Alaska trout, when compared to past and current data collected from lakes stocked with Winthrop or Ennis fish, indicate that Alaska trout have consistently better survival but a slower growth than their domestic counterparts. To more directly compare Swanson, Talarik and Ennis fish, the following criteria were implemented: (1) equivalent handling of trout; (2) equal marking when possible (i.e., adipose or right or left ventral fin removal); (3) stocking of two or more strains in the same lake; and (4) sampling 1 year after stocking.

Comparative evaluation of the three brood stock candidates began with the planting of Swanson, Talarik and Ennis trout in the fall of 1974, continued with annual fish plants of the three strains through 1978, and annual survival and growth collections through 1979.

Based on the data collected and analyzed under this lake study project and related hatchery observations, the Swanson strain has been selected from the three candidate strains as brood stock for Alaska's rainbow trout hatchery facility to be used for the fry and fingerling lake stocking program.

Further investigations under this lake study program are warranted to find: (1) optimum stocking densities for lakes of various fertilities both with and without competitor species; (2) the proper size of fish to stock and time of stocking; (3) which species or strain to stock in lakes of given limnological characteristics; (4) production costs relative to fish survival and subsequent harvest; and (5) sampling equipment and techniques to better assess fish survival and growth at various life stages.

Table 1 lists all species mentioned in this report. Table 2 give the morphoedaphic index for selected Matanuska-Susitna Valley lakes, and Figure 1 is a map showing the study area.

RECOMMENDATIONS

1. Survival, growth and total yield of Swanson strain rainbow trout plants should be determined in Florence, Irene, Reed, Weiner, Tigger and Johnson Lakes.
2. Investigations into habitat preference and rearing areas in Johnson Lake should be continued with the introduction of three marked groups of Swanson rainbow trout; one group planted from a single release site, another group released at various points around the perimeter of the lake, and a third group held in a holding pen and observed for a certain length of time before being liberated.
3. Swanson strain rainbow trout should be planted in selected study lakes at densities commensurate with available littoral area and survival, growth and biomass production related to MEI should be determined.
4. Techniques and equipment necessary to determine survival, growth and yield of stocked game fishes should be developed.
5. Costs to the creel should be obtained for fish stocked in study lakes when harvest estimates are available.

OBJECTIVES

1. To determine survival, growth and total yield of stocked game fishes in landlocked lakes of the area.
2. To determine limnological conditions which affect survival, immediately following introduction, of game fishes stocked in study lakes.
3. To provide recommendations for the management of stocked lakes and to direct the course of future studies.

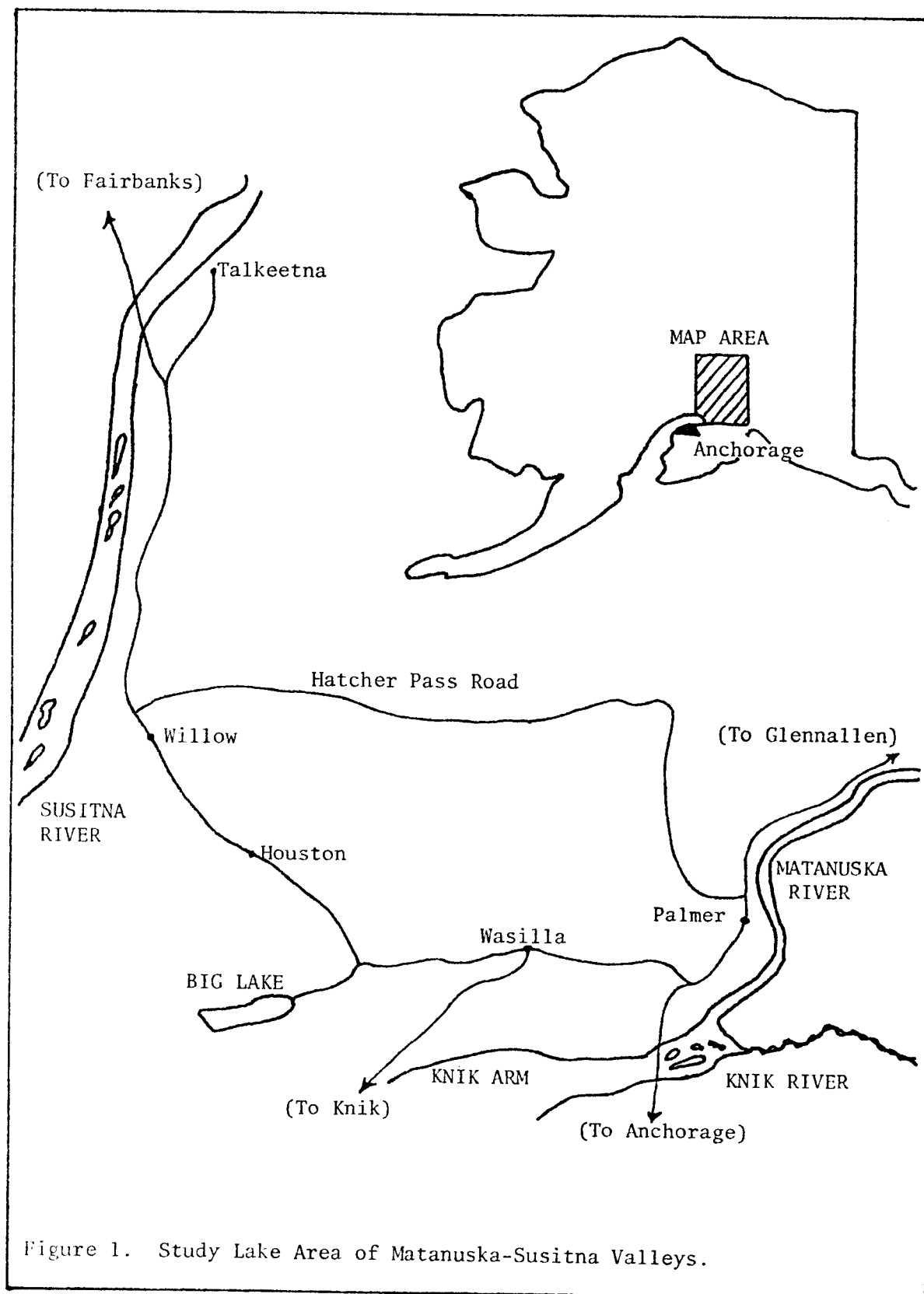


Figure 1. Study Lake Area of Matanuska-Susitna Valleys.

Table 1. List of Common Names, Scientific Names and Abbreviations

Common Name	Scientific Name and Author	Abbreviation
Rainbow trout	<u>Salmo gairdneri</u> Richardson	RT
Coho salmon	<u>Oncorhynchus kisutch</u> (Walbaum)	SS
Threespine stickleback	<u>Gasterosteus aculeatus</u> Linnaeus	TST
Ninespine stickleback	<u>Pungitius pungitius</u> (Linnaeus)	NSB

Table 2. Morphoedaphic Index Values for Selected Lakes in the Matanuska-Susitna Valleys (Watsjold, 1976).

Lake	MEI*	Lake	MEI*
Lucille	23.5	Memory	5.3
Harriet	21.3	Reed	4.9
Canoe	18.1	Meirs	3.4
Falk	16.7	Rocky	3.1
Echo	15.9	Christiansen	1.8
Seymour	14.6	Benka	1.3
Finger	13.3	Loon	1.3
Junction	13.2	South Rolly	1.2
Kepler	11.6	Big No Luck	1.1
Irene	10.4	Twelve Mile	1.0
Long	9.4	Prator	0.9
Victor	9.3	Milo #1	0.7
Knik	9.1	Chicken	0.5
Matanuska	8.2	Byers	0.5
Florence	7.6	Marion	0.4
Johnson	7.4		

* MEI (morphoedaphic index) = conductance divided by mean depth. MEI gives a gross measure of relative potential productivity useful for categorizing and management purposes. MEI values above 13 are most productive, values below 3 are least productive, while values between 3 and 13 range from moderately low to moderately high in productivity (Chlupach, 1978).

TECHNIQUES USED

Rainbow trout populations in Marion, Ravine, Big No Luck, Irene and Johnson Lakes were determined by Chapman's modification of the Peterson estimator and by Chapman's modification of the Schnabel multiple census estimate of population size (Ricker, 1975).

In each lake, fish were captured for marking purposes with fyke nets. Fyke nets measured 3.7 m (12 ft) in length, were 1 m (40 in) in diameter and included two 1.2 m X 1.8 m (4 ft X 25 ft) wings. Two square aluminum frames and five aluminum hoops supported the entrance and body of the fyke net. Internal throats, body and wings were of 9.5 mm (.375 in) square mesh knotless nylon.

All captured rainbow were anesthetized and marked by removing the adipose fin. Marked fish were then measured, enumerated and released. Fish were later recaptured using 38.1 m X 1.8 m (125 ft X 6 ft) variable mesh monofilament gill nets composed of five different mesh sizes ranging from 12.7 mm to 40.8 mm (0.5 in to 2 in) bar measure.

Catch rates and growth of fish were also determined by using variable mesh gill nets and 6.4 mm (0.25 in) or 3.2 mm (.125 in) square wire mesh minnow traps painted green and brown and baited with salmon eggs. Nets and traps were usually fished for 24 hours.

All fish measurements were expressed in fork lengths to the nearest millimeter and in weight to the nearest gram. Fish biomass estimates were converted from total grams to pounds.

Swanson strain rainbow trout stocked in study lakes in October 1979 were first anesthetized and marked at the hatchery by removing the adipose fin.

FINDINGS

Selection of Rainbow Trout Brood Stock

A segment of the second phase of the lake study program has been concluded with the selection of a rainbow trout strain for Alaska's brood stock program. The selection was based upon evaluation of data collected concerning the survival and growth of the three rainbow trout brood stock candidates--the Swanson River strain, the Talarik Creek strain and the Alaska Ennis strain.

Survival:

Gill Net Catches. Chlupach (1976, 1977 and 1978) and Havens (1979) presented rainbow trout survival data by strain for study lakes in the Matanuska-Susitna Valleys, the Glennallen area and the Kenai Peninsula. Net catches from 1974 through 1979 (Table 3) show a consistently higher survival of the Swanson strain as evidenced by chi-square analysis and percent superiority calculations (Table 4). Gill net catch rates for Age I Swanson trout, that is trout that have been in a lake environment for 11 to 13 months, averaged 2.30 fish per hour, Talarik 0.91 fish per hour, and

Table 3. Stocking and Gill Net Catch Data for Age I Swanson, Talarik and Ennis Rainbow Trout Strains in Selected Stocked Lakes of the Southcentral Area, 1974-1979.

Lake	Strain*	Date Stocked	Number Stocked	Size Fish/lb.	Density Fish/a	Capture Date	Number Caught	Fish Per Gill Net Hr.	Total Fish/hr.
Big No Luck**	S	10/1/75	4,300	296	96	10/9/76	250	3.26	3.98
	T	10/1/75	2,200	225		10/9/76	55	0.72	
	S	9/6/78	2,250	213	99	9/28/79	147	2.08	2.54
	T	9/6/78	2,250	189		9/28/79	33	0.47	
	E	9/6/78	2,250	164		9/28/79	0	0	
Canoe	S	10/1/75	2,625	292	250	10/13/76	70	0.97	0.97
	T	10/1/75	2,625	226		10/13/76	0	0	
Florence	S	10/3/77	7,333	130	201	9/14/78	424	6.14	6.17
	E	10/3/77	3,666	103		9/14/78	2	0.03	
Irene	S	10/5/76	2,100	227	300	9/16/77	176	2.44	3.51
	T	10/5/76	2,100	117		9/16/77	73	1.01	
	E	10/5/76	2,100	119		9/16/77	4	0.06	
	S	9/5/78	1,200	213	200	10/17/79	120	1.28	1.63
	T	9/5/78	1,200	189		10/17/79	29	0.31	
	E	9/5/78	1,200	164		10/17/79	4	0.04	
Johnson	S	9/7/78	4,000	213	298	1979***	634	0.23	0.31
	T	9/7/78	4,000	189		1979***	210	0.07	
	E	9/7/78	4,000	164		1979***	18	0.01	
Kepler	S	9/11/75	8,700	388	385	9/16/76	129	1.65	1.68
	E	7/21/75	8,700	138		9/16/76	2	0.03	
Knik**	S	10/5/76	12,641	239	285	10/20/77	442	6.70	8.91
	E	5/16/77	20,000	156	650	10/20/77	146	2.21	

Table 3 (cont.). Stocking and Gill Net Catch Data for Age I Swanson, Talarik and Ennis Rainbow Trout Strains in Selected Stocked Lakes of the Southcentral Area, 1974-1979.

Lake	Strain*	Date Stocked	Number Stocked	Size Fish/lb.	Density Fish/a	Capture Date	Number Caught	Fish Per Gill Net Hr.	Total Fish/hr.
Long**	S	6/20/75	1,000	11	55	10/9/75	83	0.86	1.34
	T	6/20/75	3,056	11		10/9/75	46	0.47	
	S	10/5/76	14,800	227	300	9/12/77	333	2.83	2.92
	E	10/5/76	7,400	119		9/12/77	11	0.09	
	S	10/3/77	9,866	130	199	10/16/78	440	3.38	3.40
	E	10/3/77	4,933	103		10/16/78	2	0.02	
Marion	S	10/4/76	4,250	227	76	9/1/77	56	2.33	4.33
	T	10/4/76	4,250	117		9/1/77	48	2.00	
	S	9/11/78	4,560	248	113	10/9/79	147	1.79	2.24
	T	9/11/78	3,825	180		10/9/79	37	0.45	
	E	9/11/78	4,335	136		10/9/79	0	0	
Matanuska**	S	10/4/76	15,000	227	403	9/12/77	309	3.40	3.49
	E	10/4/76	10,000	119		9/12/77	8	0.09	
North Jans***	S	10/4/77	8,000	131	207	9/14/78	163	1.72	1.81
	E	10/4/77	4,000	104		9/14/78	9	0.09	
North Joseph**/****	S	10/4/77	4,000	131	273	10/10/78	30	0.67	0.75
	E	10/4/77	2,000	104		10/10/78	4	0.08	
Ravine	S	10/5/76	1,200	227	200	9/18/77	115	1.20	1.44
	E	10/5/76	1,200	119		9/18/77	23	0.24	
	S	9/5/78	800	213	200	10/10/78	88	1.92	2.55
	T	9/5/78	800	189		10/10/78	25	0.55	
	E	9/5/78	800	164		10/10/78	4	0.09	

Table 3 (cont.). Stocking and Gill Net Catch Data for Age I Swanson, Talarik and Ennis Rainbow Trout Strains in Selected Stocked Lakes of the Southcentral Area, 1974-1979.

Lake	Strain*	Date Stocked	Number Stocked	Size Fish/lb.	Density Fish/a	Capture Date	Number Caught	Fish Per Gill Net Hr.	Total Fish/hr.
Reed	S	10/10/74	1,500	132	354	10/2/75	123	1.23	5.24
	T	10/10/74	5,578	98		10/2/75	401	4.01	

* Strain: S = Swanson T = Talarik E = Ennis

** These waters contain stickleback populations.

*** Gill net capture dates are from 6/28/79 to 10/26/79 with a total of 2,810 gill net hours fished.

**** North Jans Lake is located in the Glennallen area, North Joseph Lake on the Kenai Peninsula and the remainder of the lakes referred to in Table 3 are located in the Matanuska-Susitna Valleys.

Table 4. Comparative Survivals and Percent Superiority for Swanson, Talarik and Ennis Rainbow Trout Strains, 1974-1979.

Lake	Strain*	Number Stocked	Observed Captured	Expected Capture	Chi-Square Totals	Tabled Chi (p=0.05) Square	Percent** Superiority
Big No Luck***	S	4,300	250	202	32.63	1 d.f.	133
	T	2,200	55	103		3.84	
	S	2,250	147	60	203.73	2 d.f.	345
	T	2,250	33	60		5.99	
	E	2,250	0	60			
Canoe	S	2,625	70	35	70.94	1 d.f.	
	T	2,625	0	35		3.84	
Florence	S	7,333	424	284	215.38	1 d.f.	10,499
	E	3,666	2	142		3.84	
Irene	S	2,100	176	84	185.82	2 d.f.	141
	T	2,100	73	84		5.99	4,300
	E	2,100	4	84			
	S	1,200	120	51	152.63	2 d.f.	314
	T	1,200	29	51		5.99	2,900
	E	1,200	4	51			
Johnson	S	4,000	634	287	745.85	2 d.f.	202
	T	4,000	210	287		5.99	3,422
	E	4,000	18	287			
Kepler	S	8,700	129	65	125.01	1 d.f.	6,350
	E	8,700	2	65		3.84	
Knik	S	12,641	442	228	334.09	1 d.f.	379
	E	20,000	146	360		3.84	

Table 4 (cont.). Comparative Survivals and Percent Superiority for Swanson, Talarik and Ennis Rainbow Trout Strains, 1974-1979.

Lake	Strain*	Number Stocked	Observed Captured	Expected Capture	Chi-Square Totals	Tabled Chi (p=0.05) Square	Percent** Superiority
Long***	S	1,000	83	32	111.10	1 d.f.	451
	T	3,056	46	97		3.84	
	S	14,800	333	229	143.50	1 d.f.	1,414
	E	7,400	11	115		3.84	
	S	9,866	440	295	220.89	1 d.f.	10,900
	E	4,933	2	147		3.84	
Marion	S	4,250	187	172	2.73	1 d.f.	17
	T	4,250	157	172		3.84	
	S	4,560	147	66	170.78	2 d.f.	233
	T	3,825	37	55		5.99	
	E	4,335	0	63			
Matanuska***	S	15,000	309	190	188.42	1 d.f.	2,475
	E	10,000	8	127		3.84	
North Jans	S	8,000	163	114	62.36	1 d.f.	806
	E	4,000	9	57		3.84	
North Joseph***	S	4,000	30	23	6.61	1 d.f.	275
	E	2,000	4	11		3.84	
Ravine	S	1,200	115	69	65.08	1 d.f.	400
	E	1,200	23	69		3.84	
	S	800	88	39	103.03	2 d.f.	252
	T	800	25	39		5.99	
	E	800	4	39			

Table 4 (cont.). Comparative Survivals and Percent Superiority for Swanson, Talarik and Ennis Rainbow Trout Strains, 1974-1979.

Lake	Strain*	Number Stocked	Observed Captured	Expected Capture	Chi-Square Totals	Tabled Chi (p=0.05) Square	Percent** Superiority
Reed	S	1,500	123	100	8.98	1 d.f.	43
	T	2,578	148	171		3.84	

* Strain: S = Swanson T = Talarik E = Ennis

$$** \% = 100 \left[\frac{(\text{number captured strain A}) (\text{number stocked strain B})}{(\text{number captured strain B}) (\text{number stocked strain A})} - 1 \right]$$

These figures represent the percent superiority of the Swanson strain over the Talarik strain or the Ennis strain.

*** These waters contain stickleback populations.

Ennis trout only 0.21 fish per hour. Gill net catches and catch rates for Age II Swanson, Talarik and Ennis trout indicate the same survival sequence as found for Age I catches. At Age III and IV, however, the few Ennis fish that had initially survived to Age I and II have generally disappeared, and the percent superiority of Swanson trout over the Talarik strain has increased.

Population Estimates. Eleven population estimates from 1970 through 1977, in four study lakes for plants of domestic Ennis and Winthrop fish (Chlupach, 1978), ranged from 0 to 24% and averaged 8% in low to moderately productive Matanuska-Susitna Valley lakes. Similar survivals of stocked domestic rainbow trout for interior Alaska lakes were also noted by Peckham (1974 and 1975). Population estimates for plants of domestic and native Alaska trout conducted in 1978 (Havens, 1979), revealed survivals of Swanson fish from 23% to 57%, Talarik 40% and Ennis less than 1%. This divergence of the Ennis trout from past average survival percentages (i.e., less than 1% versus 8%) reflects the difference between planting Ennis fish in competition with native Alaska trout rather than planting only domestic fish in a lake and indicates that native Alaska trout, the Swanson strain in particular, compete more successfully in situations considered normal within the parameters of southcentral Alaska's lake stocking program.

As a final comparison of survival and growth of Swanson, Talarik and Ennis strain rainbow trout, five Matanuska-Susitna Valley lakes of widely varying limnological parameters (Table 5) were each stocked with equal ratios of the three rainbow trout brood stock candidate strains in September 1978. Havens (1979) reported minnow trapping in the five study lakes, approximately 1 month after stocking, showed a much higher catch rate for Swanson fish than either Talarik or Ennis trout, and that stomach contents of gill-netted Age II Swanson and Talarik trout in Marion Lake contained a disproportionately higher percentage of newly planted Ennis strain fingerlings than the Talarik or Swanson strains. These findings suggested a greater initial survival of the Swanson strain in each of the five lakes. Population estimates 1 year later in the fall of 1979 agreed with 1978 minnow trapping data in that the percent composition of each strain in each lake maintained the same order and a similar level of dominance (Table 6). Chi-square analysis of the catches by each sampling method (i.e., minnow traps, fyke nets and gill nets) disclosed a statistically significant difference, at the 95% confidence level, between the catches of Swanson, Talarik and Ennis rainbow trout. Apparently, whatever caused a selective die-off between the three strains in all five lakes took place within a month after stocking, and that any mortality after that period was similar for all three strains.

Using a modified Peterson population estimate, the survivals of Swanson fish in the five lakes sampled in 1979 and the three lakes sampled in 1978 ranged from a low of 20% to a high of 57% with a combined average of 32%. Talarik survivals, on the other hand, ranged from 8% to 40% with a combined average of 18% and the Ennis survivals, determined by relative gill net catches, ranged from 0 to 3% and averaged less than 1%. These estimates, in most cases, must be considered minimal because of unknown or unmeasured recreational harvest. Data indicate overall Swanson survivals were about two times greater than Talarik survivals and approximately 70 times greater than Ennis survivals.

Table 5. Limnological Parameters of Selected Matanuska-Susitna Valley Lakes, 1978-1979.

Lake	MEI*	Surface (Acres)	Volume (Acre- feet)	Littoral** Area (Acres)	Maximum Depth (Feet)	Shoreline Distance (Miles)	Stickleback Present	Rainbow from Prior Plants Present
Big No Luck	1.1	67.9	470	36.0	40	1.995	Yes	Yes
Irene	10.4	18.0	384	6.7	42	0.777	No	Yes
Johnson	7.4	40.3	806	18.5	46	1.089	No	Yes
Marion	0.4	113.0	2,324	37.3	42	2.652	No	Yes
Ravine	20.0	12.3	146	7.6	25	0.824	No	Yes

* Ravine Lake MEI is approximated at 20 when the water characteristics of hardness and total alkalinity are compared to lakes having similar water characteristics.

** Littoral area is that portion of the lake less than 15 ft in depth.

Table 6. Percent Composition by Strain for Swanson, Talarik and Ennis Rainbow Trout in Five Matanuska-Susitna Valley Lakes, 1978-1979.

Lake	Strain*	Number Stocked in September 1978	Minnow Trap Catch October 1978		Gill Net Catch to October 1979		Fyke Net Catch to October 1979		Peterson Population Estimate October 1979		
			Number Caught	Percent Catch by Strain	Number Caught	Percent Catch by Strain	Number Caught	Percent Catch by Strain	Number	Percent Survival	Percent Population by Strain
Big No Luck**	S	2,250	80	65	147	82	280	78	538	24	74
	T	2,250	37	30	33	18	78	22	189	8	26
	E	<u>2,250</u>	<u>6</u>	<u>5</u>	<u>0</u>	<u>—</u>	<u>0</u>	<u>—</u>	<u>0</u>	<u>—</u>	<u>—</u>
	Total	6,750	123	100	180	100	358	100	727	11	100
Irene	S	1,200	66	71	120	78	85	79	245	20	70
	T	1,200	21	23	29	19	22	21	94	8	27
	E	<u>1,200</u>	<u>6</u>	<u>6</u>	<u>4</u>	<u>3</u>	<u>0</u>	<u>—</u>	<u>9</u>	<u>1</u>	<u>3</u>
	Total	3,600	93	100	153	100	107	100	348	10	100
Johnson	S	4,000	437	80	690	74	61	84	919	23	68
	T	4,000	88	16	221	24	12	16	398	10	29
	E	<u>4,000</u>	<u>24</u>	<u>4</u>	<u>24</u>	<u>2</u>	<u>0</u>	<u>—</u>	<u>35</u>	<u>1</u>	<u>3</u>
	Total	12,000	549	100	935	100	73	100	1,352	11	100
Marion	S	4,560	101	60	217	78	103	88	916	20	74
	T	3,825	63	37	63	22	14	12	324	8	26
	E	<u>4,335</u>	<u>5</u>	<u>3</u>	<u>0</u>	<u>—</u>	<u>0</u>	<u>—</u>	<u>0</u>	<u>—</u>	<u>—</u>
	Total	12,720	169	100	280	100	117	100	1,240	10	100

Table 6 (cont.). Percent Composition by Strain for Swanson, Talarik and Ennis Rainbow Trout in Five Matanuska-Susitna Valley Lakes, 1978-1979.

Lake	Strain*	Number Stocked in September 1978	Minnow Trap Catch October 1978		Gill Net Catch to October 1979		Fyke Net Catch to October 1979		Peterson Population Estimate October 1979		
			Number Caught	Percent Catch by Strain	Number Caught	Percent Catch by Strain	Number Caught	Percent Catch by Strain	Number	Percent Survival	Percent Population by Strain
Ravine	S	800	26	57	88	75	137	74	435	54	65
	T	800	19	41	25	21	49	26	212	27	32
	E	800	1	2	4	4	0		23	3	3
	Total	2,400	46	100	117	100	186	100	670	28	100
TOTAL ALL LAKES	S	12,810	710	73	1,262	76	666	79	3,053	24	70
	T	12,075	228	23	371	22	175	21	1,217	10	28
	E	12,585	42	4	32	2	0		67	0.5	2
	Total	37,470	980	100	1,665	100	841	100	4,337	12	100

* Strain: S = Swanson (left ventral clip) T = Talarik (right ventral clip) E = Ennis (adipose clip).

** These waters contain stickleback populations.

Table 7. Length-Weight Summaries for Age I Swanson, Talarik and Ennis Rainbow Trout in Selected Lakes of the Southcentral Area, 1974-1979.

Lake	Strain*	Date Stocked	Number Stocked	Capture Date	Number Captured	Mean L (mm)	SD _L	Mean W (g)	SD _W	C.F.**
Big No Luck***	S	10/1/75	4,300	10/9/76	250	177	14	60	17	1.08
	T	10/1/75	2,200	10/9/76	55	193	26	79	28	1.09
	S	9/6/78	2,250	9/28/79	147	179	13	65	15	1.13
	T	9/6/78	2,250	9/28/79	33	181	21	70	22	1.18
	E	9/6/78	2,250	9/28/79	0					
Canoe	S	10/1/75	2,625	10/13/76	70	304	23	421	115	1.49
	T	10/1/75	2,625	10/13/76	0					
Florence	S	10/3/77	7,333	9/14/78	424	195	24	90	35	1.21
	E	10/3/77	3,666	9/14/78	2	296		377		1.45
Irene	S	10/5/76	2,100	9/16/77	176	193	20	82	35	1.14
	T	10/5/76	2,100	9/16/77	73	231	30	136	50	1.10
	E	10/5/76	2,100	9/16/77	4	253	19	206	31	1.27
	S	9/5/78	1,200	10/17/79	120	251	26	186	55	1.18
	T	9/5/78	1,200	10/17/79	29	238	28	163	58	1.21
	E	9/5/78	1,200	10/17/79	4	322	16	503	66	1.51
Johnson	S	9/7/78	4,000	10/23/79	69	229	26	141	45	1.17
	T	9/7/78	4,000	10/23/79	14	230	38	153	74	1.26
	E	9/7/78	4,000	10/23/79	1	276		283		1.35
Kepler	S	9/11/75	8,700	9/16/76	129	172	21	63	29	1.23
	E	7/21/75	8,700	9/16/76	2	319		380		1.17
Knik***	S	10/5/76	12,641	10/20/77	130	156	31	53	24	1.39
	E	5/16/77	20,000	10/20/77	43	196	14	111	22	1.47

Table 7 (cont.). Length-Weight Summaries for Age I Swanson, Talarik and Ennis Rainbow Trout in Selected Lakes of the Southcentral Area, 1974-1979.

Lake	Strain*	Date Stocked	Number Stocked	Capture Date	Number Captured	Mean L (mm)	SD _L	Mean W (g)	SD _W	C.F.**
Long***	S	6/20/75	1,000	10/9/75	83	247	32	180	75	1.19
	T	6/20/75	3,056	10/9/75	46	245	27	166	54	1.12
	S	10/5/76	14,800	9/12/77	333	161	32	62	35	1.48
	E	10/5/76	7,400	9/12/77	11	271	36	312	120	1.56
	S	10/3/77	9,866	10/16/78	440	193	34	87	49	1.21
	E	10/3/77	4,933	10/16/78	2	171		68		1.36
Marion	S	10/4/76	4,250	9/1/77	56	153	24	39	23	1.08
	T	10/4/76	4,250	9/1/77	48	190	32	72	34	1.04
	S	9/11/78	4,560	10/9/79	147	180	15	53	13	1.08
	T	9/11/78	3,825	10/9/79	37	193	20	82	24	1.14
	E	9/11/78	4,335	10/9/79	0					
Matanuska***	S	10/4/76	15,000	9/12/77	309	179	23	72	30	1.25
	E	10/4/76	10,000	9/12/77	8	252	30	230	68	1.43
North Jans	S	10/4/77	8,000	9/14/78	163	222	34	...	...	....
	E	10/4/77	4,000	9/14/78	9	245	38	...	...	.....
North Joseph***	S	10/4/77	4,200	10/10/78	30	202	37	110	67	1.33
	E	10/4/77	2,000	10/10/78	4	298	52	418	254	1.58
Ravine	S	10/5/76	1,200	9/8/77	115	208	23	113	39	1.25
	E	10/5/76	1,200	9/8/77	23	230	29	169	79	1.38
	S	9/5/78	800	9/21/79	88	234	22	155	42	1.21
	T	9/5/78	800	9/21/79	25	230	23	152	43	1.25
	E	9/5/78	800	9/21/79	4	265	9	266	38	1.43

Table 7 (cont.). Length-Weight Summaries for Age I Swanson, Talarik and Ennis Rainbow Trout in Selected Lakes of the Southcentral Area, 1974-1979.

Lake	Strain*	Date Stocked	Number Stocked	Capture Date	Number Captured	Mean L (mm)	SD _L	Mean W (g)	SD _W	C.F.**
Reed	S	10/10/74	1,500	10/2/75	123	180	16	61	19	1.04
	T	10/10/74	5,578	10/2/75	401	183	16	65	19	1.06

* Strain: S = Swanson T = Talarik E = Ennis.

** C.F. = Condition Factor = $\frac{100,000 W}{L^3}$

*** These waters contain stickleback populations.

Table 8. A Comparison of Biomass Production By All Age Classes of Rainbow Trout in Selected Stocked Lakes of the Matanuska-Susitna Valleys, 1979.

Lake	MEI	Surface Area (Acres)	Littoral* Area (Acres)	Strain**	Stocking		Population Estimate		Pounds Produced Per Surface Acre	Pounds Produced Per Littoral Acre	Total Pounds Produced
					Year	Number	Year	Number			
Ravine	20.0	12.3	7.6	S	1976	1,200	1979	29	7.4	3.8	91
				E	1976	1,200	1979	0	0	0	0
				S	1978	800	1979	435	12.1	19.6	149
				T	1978	800	1979	212	5.8	9.3	71
				E	1978	800	1979	23	1.0	1.6	12
TOTAL						4,800		699	26.3	34.3	323
Irene	10.4	18.0	6.6	S	1976	2,100	1979	16	2.7	7.4	49
				T	1976	2,100	1979	4	1.0	2.7	18
				E	1976	2,100	1979	4	1.0	2.7	18
				S	1978	1,200	1979	245	5.6	15.2	100
				T	1978	1,200	1979	94	1.9	5.2	34
				E	1978	1,200	1979	9	0.6	1.5	10
Total						9,900		372	12.7	34.7	229
Long***	9.4	74.4	20.8	S	1976	14,800	1978	225	3.7	13.1	273
				E	1976	7,400	1978	5	0.1	0.3	7
				S	1977	9,866	1978	2,291	5.9	21.1	439
				E	1977	4,933	1978	10	0	0.1	2
Total						36,999		2,531	9.7	34.7	721
Florence	7.6	54.6	28.9	W	1974	30,000	1978	37	2.7	5.1	146
				S	1977	7,333	1978	2,628	9.2	17.4	504
				E	1977	3,666	1978	16	0.2	0.4	11
Total						40,999		2,681	12.1	22.9	661

Table 8 (cont.). A Comparison of Biomass Production By All Age Classes of Rainbow Trout in Selected Stocked Lakes of the Matanuska-Susitna Valleys, 1979.

Lake	MEI	Surface Area (Acres)	Littoral* Area (Acres)	Strain**	Stocking		Population Estimate		Pounds Produced Per Surface Acre	Pounds Produced Per Littoral Acre	Total Pounds Produced
					Year	Number	Year	Number			
Johnson***	7.4	40.3	18.5	E	1976	12,000	1979	210	10.9	23.8	441
				E	1977	8,000	1979	0	0	0	0
				S	1978	4,000	1979	919	5.3	11.5	213
				T	1978	4,000	1979	398	2.7	6.0	110
				E	1978	4,000	1979	35	0.5	1.0	19
						<u>32,000</u>		<u>1,562</u>	<u>19.4</u>	<u>42.3</u>	<u>783</u>
Total											
Big No Luck***	1.1	67.9	36.0	S	1975	4,500	1979	68	1.0	1.8	65
				T	1975	2,300	1979	12	0.2	0.4	14
				S	1978	2,500	1979	538	1.1	2.1	77
				T	1978	2,500	1979	189	0.4	0.8	29
				E	1978	2,500	1979	0	0	0	0
						<u>14,300</u>		<u>807</u>	<u>2.7</u>	<u>5.1</u>	<u>185</u>
Total											
Marion	0.4	113.0	37.3	E,W	1974-5	20,600	1978	550	12.4	37.8	1,408
				S	1976	4,250	1978	2,432	2.8	8.3	311
				T	1976	4,250	1978	1,706	1.8	5.4	203
						<u>29,100</u>		<u>4,688</u>	<u>17.0</u>	<u>51.5</u>	<u>1,922</u>
Total											
				E,W	1974-5	20,600	1979	74	1.3	4.0	148
				S	1976	4,250	1979	174	1.6	4.7	176
				T	1976	4,250	1979	139	1.4	4.4	167
				S	1978	4,560	1979	916	0.8	2.3	85
				T	1978	3,825	1979	324	0.5	1.6	59
				E	1978	4,335	1979	0	0	0	0
						<u>41,820</u>		<u>1,627</u>	<u>5.6</u>	<u>17.0</u>	<u>635</u>
Total											

* Littoral area is that portion of the lake less than 15 ft deep

** Strain: E = Ennis W = Winthrop S = Swanson T = Talarik

*** These waters contain stickleback populations

**** Johnson Lake had no known recreational harvest

Table 9. A comparison of Biomass Production by Age I Rainbow Trout Strains in Five Stocked Matanuska-Susitna Valley Lakes, 1979.

Lake	MEI	Surface Area (Acres)	Littoral* Area (Acres)	Strain**	Pounds Stocked Fall 1978	Pounds Available Fall 1979	Pounds per Surface Acre Fall 1979	Pounds per Littoral Acre Fall 1979	Pounds Produced per Pound of Fish Stocked
Ravine	20.0	12.3	7.6	S	3.76	149	12.1	19.6	39.5
				T	4.23	71	5.8	9.3	16.8
				E	<u>4.88</u>	<u>14</u>	<u>1.1</u>	<u>1.8</u>	<u>2.9</u>
				Total	12.87	234	19.0	30.7	18.2
Irene	10.4	18.0	6.6	S	5.63	100	5.6	15.2	17.8
				T	6.34	34	1.9	5.2	5.3
				E	<u>7.32</u>	<u>10</u>	<u>0.6</u>	<u>1.5</u>	<u>1.4</u>
				Total	19.29	144	8.1	21.9	7.5
Johnson***	7.4	40.3	18.5	S	18.78	213	5.3	11.5	11.3
				T	21.16	110	2.7	6.0	5.2
				E	<u>24.39</u>	<u>19</u>	<u>0.5</u>	<u>1.0</u>	<u>0.8</u>
				Total	64.33	342	8.5	18.5	5.3
Marion	0.4	113.0	37.3	S	18.39	127	1.1	3.4	6.9
				T	21.25	59	0.5	1.6	2.8
				E	<u>31.88</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
				Total	71.52	186	1.6	5.0	2.6
Big No Luck****	1.1	67.9	36.0	S	10.56	77	1.1	2.1	7.3
				T	11.90	29	0.4	0.8	2.4
				E	<u>13.72</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
				Total	36.18	106	1.5	2.9	2.9

* Littoral acres is that portion of the lake less than 15 ft deep.

** Strain: S = Swanson T = Talarik E = Ennis

*** Johnson Lake had no known recreational harvest

**** Big No Luck Lake has threespine and ninespine stickleback populations

Growth:

An assessment of growth between the Swanson, Talarik and Ennis strains, in selected southcentral Alaska stocked lakes from 1974 through 1979, indicates the native Alaska trout have substantially slower growth than the Ennis fish (Table 7). Combined average lengths for Age I Ennis rainbow trout are 234 mm (9.2 in), Talarik 197 mm (7.8 in) and Swanson 193 mm (7.6 in). Swanson fish, although slower growing than either Talarik or Ennis trout, reach a harvestable size at Age I.

Final Selection:

In every situation where Swanson trout were compared to Talarik or Ennis fish, in stickleback infested waters, rehabilitated lakes, lakes containing larger trout from prior plants, lakes relatively free from competitor or predator species and in lakes ranging from those with low to those with high relative fertilities, all available sampling data reflect the superior survival of the Swanson strain. Cursory harvest data, collected incidental to other lake studies from 1975 through 1979, indicate Swanson catchability is at least equal to that of the Talarik and Ennis strains while the greater number of Swansons caught is related to their greater survivals. Hatchery performance of the Swanson trout from 1974 to the present is comparable to that of the Ennis and Talarik in normal hatchery rearing situations, but substantially exceeds both the Ennis and Talarik strains in the percentage of egg to fry survival according to Gary Wall, Anchorage Area Hatchery Manager, Alaska Department of Fish and Game (pers. comm.).

Stocked Lake Evaluation

Biomass:

In conjunction with survival estimates made during population sampling, total biomass (fish weight) related to lake morphologies and respective lake productivities was examined.

Biomass in pounds of fish per surface acre ranged from a high of 26.3 in Ravine Lake to a low of 2.7 in Big No Luck Lake, while the combined average for all estimates was 11.1. Like previously mentioned population estimates, these biomass estimates should be considered minimal because of unknown or unmeasured harvest although Johnson Lake, in 1979, and Marion Lake, in 1978, had virtually no recreational harvest on prior year rainbow trout plants. Table 8 shows total pounds of stocked fish estimated to be in each lake at the time the population was sampled.

Table 9 gives a comparison of biomass production in each lake and between lakes of differing productivity levels for Swanson, Talarik and Ennis rainbow trout strains planted in 1978. Significant correlation exists between MEI (morphoedaphic index values) and pounds of fish per surface acre ($r = 0.99$), MEI and pounds of fish per littoral acre ($r = 0.97$) and MEI and pounds of fish produced per pound of fish stocked ($r = 0.97$). Watsjold (1976) presented data that showed a correlation between growth rates of coho salmon and MEI for five stocked Matanuska-Susitna Valley lakes, but similar comparisons between growth curves of stocked domestic rainbow trout and MEI indicated correlations did not exist, most likely due to low sur-

Table 10. Minnow Trap Catches and Catch Rates for Rainbow Trout Fingerling in Johnson Lake, 1979.

Lake Depth (Feet)	Under Ice*			During Ice Free Period							Number Caught 5/79-10/79	Combined CPUE 5/79-10/79
	Number Caught 4/79	Hours Fished 4/79	CPUE 4/79	Number Caught					Hours Fished 6/79-10/79			
				5/79	6/79	8/79	9/79	10/79				
0-5	66	416	0.1587	87	28	118	125	140	9,159	498	.0544	
6-10	175	1,946	.0899	0	0	1	0	0	3,635	1	.0003	
11-20	2	700	.0029	0	0	0	0	0	3,240	0	0	
21-30	0	560	0	0	0	0	0	0	1,128	0	0	
31-40	0	0	0	0	0	0	0	0	632	0	0	
41-46	—	0	—	0	0	0	0	0	1,056	0	0	
Total	243	3,622	.0671	87	28	119	125	140	18,850	499	.0265	

* As ice depth was approximately 36 inches, most minnow traps fished at indicated 6-10 ft depth were actually in less than 6 ft of water.

vivals. This cursory investigation illustrates the need for addition research into the important subject of potential biomass production as related to fish stocking densities.

Johnson Lake Habitat Studies:

Studies were initiated in Johnson Lake regarding habitat preferences and rearing areas utilized by rainbow trout fingerlings to determine if a relationship existed between relative stocking densities and fish survival to catchable size. Sampling was conducted from March through August 1979 on 12,000 fingerlings stocked in September 1978, and from August through December 1979 on 7,780 fingerlings stocked in August and September 1979.

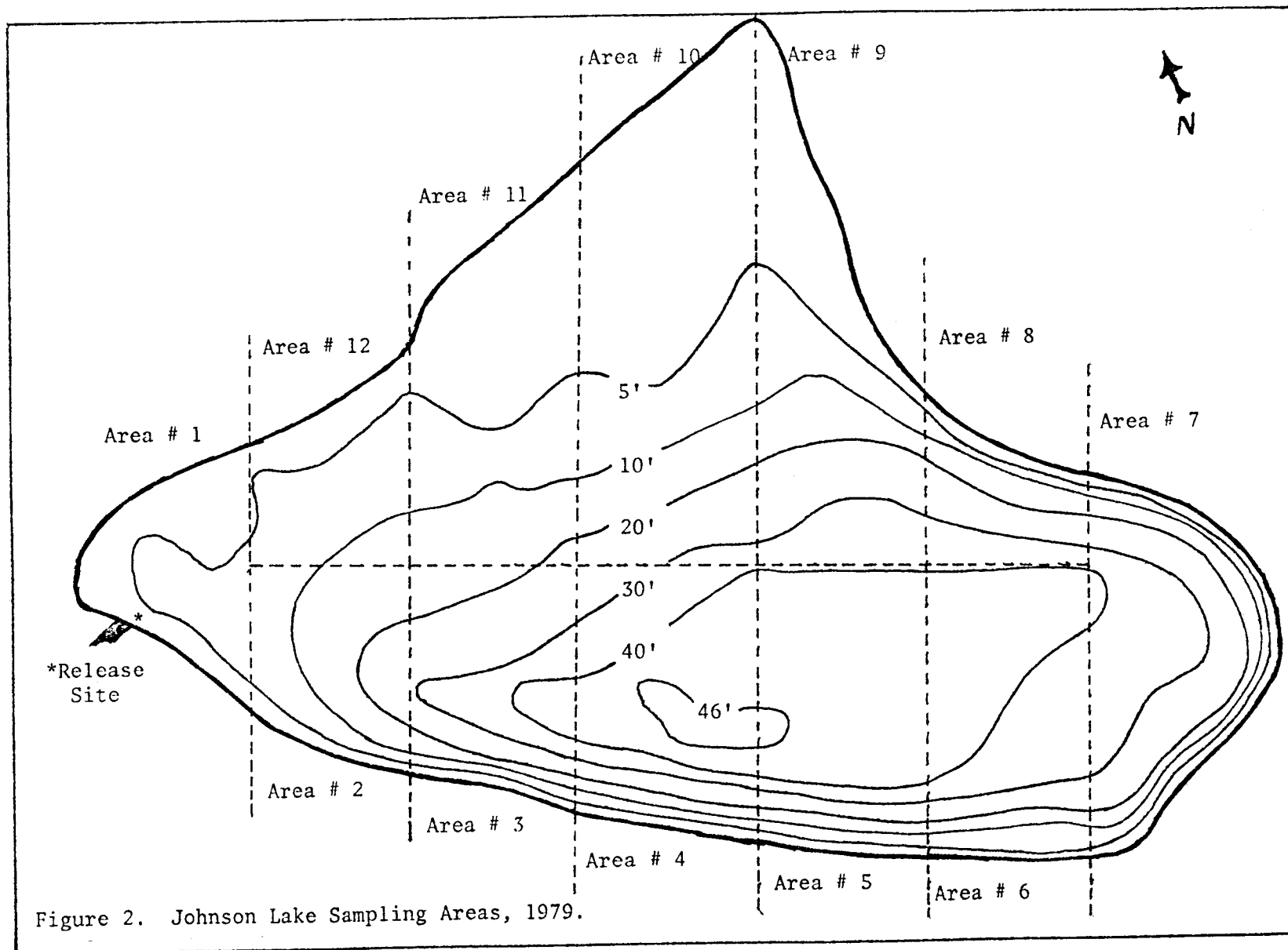
Fyke net and gill net sampling was conducted throughout the lake while minnow traps, baited with salmon eggs, were fished at various depths within 12 arbitrarily designated areas (Figure 2). Preliminary data were gathered concerning three unknowns: (1) did fingerlings utilize habitat at all depths of the lake from time of introduction in late summer until they were expected to reach catchable size (i.e., 150-200 mm, approximately 6-8 in) the following summer? (2) did fingerlings occupy the entire shoreline of the lake in equal densities or were there preferred areas where fish would tend to concentrate? (3) how long did it take for fingerlings stocked at a single release site to disperse and occupy areas around the entire perimeter of the lake?

1. During March 1979, when Johnson Lake was covered with 32-36 inches of ice, 243 rainbow trout fingerlings were minnow-trapped, all but two of which were captured in shoal areas less than 11 feet deep. From May through October 1979, 499 rainbow trout were minnow-trapped, only one of which was captured in water over 5 feet deep (Table 10). Fyke nets and gill nets fished in early June captured a total of 34 rainbow trout, all less than 120 mm in length, and all within waters 10 feet deep, even though nets capable of catching these small fish had been set in waters as deep as 30 feet.

Data collected in the end of June indicated that rainbow trout from the 1978 plant were beginning to show differential growth rates and some fish were utilizing the deeper waters of the lake. Minnow traps caught only seven rainbow trout, averaging 112 mm all in water less than 5 feet deep, fyke nets fished in water to 10 feet deep caught 47 rainbow trout with a mean length of 125 mm, while gill nets, fished at various depths throughout the lake, captured 82 rainbow trout with a mean length of 154 mm.

When sampling resumed in the first week of August, minnow traps captured no rainbow trout, while gill nets caught 303 catchable size rainbow trout from the 1978 plan with a mean length of 187 mm.

Minnow-trapping, fyke-netting and gill-netting results in Johnson Lake in 1979 indicate rainbow trout with mean lengths of less than 120 mm resided only in the fringes of the lake and spacially utilized only a small percentage of the total water volume. For



the 1978 rainbow trout plant, this would have been from the time of introduction in September 1978 until early June 1979, a period of almost 8 months. This suggests that the quantity of littoral area in a lake might be a more critical factor for rearing fish from a fry or fingerling plant to catchable size than total surface area.

2. Minnow trap catches, in areas of Johnson Lake less than 11 feet deep during the 1979 field season when all fish in the lake were potentially equally available for capture, are presented in Table 11. An examination of catch-per-unit-of-effort for each designated area indicates there might be certain areas in the lake that, because of protective cover, food availability or other unknown or unmeasured variables, juvenile rainbow trout tend to concentrate or at least be more susceptible to minnow-trapping than in other areas.
3. Johnson Lake, with 40.3 surface acres and 1.089 miles of shoreline, was stocked August 14, 1979, with 3,980 Swanson strain rainbow trout averaging 970 fish per pound. All fish were planted from a single release site in Area #1 (Figure 2). Prior to stocking, 64 small mesh baited minnow traps had been set at 45 sampling stations throughout the lake, including 27 traps around the perimeter of the lake in less than 6 feet of water. All traps were pulled, rebaited and reset twice a day for the first 3 days and once a day for the next 4 sampling days. Within 34 hours after being planted, fish were recovered from minnow traps in Area #7 at the end of the lake opposite from which they had been stocked. Within 50 hours after planting, minnow trap catches and visual observations revealed that at least a portion of the fingerlings had dispersed completely around the lake. For the entire sampling period, none of the August 14 plant was captured in locations with water depths greater than 5 feet.

This "time of dispersal" experiment was repeated in Johnson Lake when 3,800 adipose-clipped Swanson strain rainbow trout, averaging 362 fish per pound, were planted at the same single release site in Area #1 September 10, 1979. Twenty-one hours later, four adipose-clipped fingerlings were recovered from minnow traps in Areas #7 and #8 at the opposite end of the lake, and within 46 hours, clipped fish were caught in every area around the perimeter of the lake. Once again, no fish were captured in locations with water depths greater than 5 feet. Heavy concentrations of newly stocked fish were visually observed within a 50-yard radius of the release site for the first 2 days following release.

This experiment was performed to gather data about fish movement; e.g., if fish were planted at a single release site, do they tend to concentrate around that site for hours, days or weeks and, therefore, remain more susceptible to predation than if they were released at several locations around the perimeter of the lake where they could more readily seek habitat that would provide protective cover and less competition?

Table 11. Minnow Trap Catches and Catch Rates for Rainbow Trout Fingerlings Captured in Less than 11 Feet of Water in Johnson Lake, March - October 1979.

Area*	Number of Fish Captured from 1978 Plant**			Number of Fish*** Captured from 1979 Plant		Total Fish Captured	Total Hours Fished	CPUE
	S	T	E	NM	AD			
# 1	12	11	1	12	6	42	894	.047
# 2	10	8	3	17	0	38	452	.084
# 3	5	3	4	13	0	25	281	.089
# 4	3	4	0	9	1	17	428	.040
# 5	8	9	2	3	2	24	395	.061
# 6	16	9	1	1	2	29	405	.072
# 7	68	43	4	7	8	130	956	0.136
# 8	37	19	0	11	12	79	748	0.106
# 9	40	22	0	20	23	105	1,017	0.103
#10	0	0	1	9	4	14	295	.048
#11	3	3	3	0	0	9	725	.012
#12	<u>2</u>	<u>1</u>	<u>1</u>	<u>28</u>	<u>26</u>	<u>58</u>	<u>518</u>	<u>0.112</u>
Total	204	132	20	130	84	570	7,114	.080

* Area: Refer to Figure-2

** 1978 rainbow trout plant: S = Swanson strain (left ventral clip) T = Talarik strain (right ventral clip) E = Ennis strain (adipose clip)

*** 1979 rainbow trout plant were all Swanson strain: NM = unmarked AD = adipose clip

Although cursory findings in Johnson Lake in 1979 indicate relatively complete fish dispersal from a single release site after a 2-day period following stocking, further investigation is warranted.

Effect of Stocking Size on Fish Survival

To compare survival between two stocking sizes of rainbow trout in various lake types, six Matanuska-Susitna Valley lakes were each stocked in 1979 with two size groups of fish; i.e., unmarked fingerlings at approximately 1,000/lb and adipose-clipped fingerlings at 350/lb (Table 12). Although each size group was planted in approximately equal densities, another variable--time of stocking--was not excluded from the experiment as it was not possible to obtain and stock both size groups at the same time. Preliminary sampling was conducted on Johnson, Irene, Tigger, Weiner and Florence Lakes.

Johnson Lake and Irene Lake were each sampled on October 10, 1979. Catches in Johnson Lake were 134 unmarked fingerlings and 139 adipose clips, while Irene Lake catches were 154 unmarked and 147 adipose clips. Chi-square analysis of combined fyke net and minnow trap catches for each lake revealed no statistically significant difference between the numbers of unmarked and adipose-clipped Swanson trout captured. Johnson Lake was sampled again on January 29, 1980, and two unmarked and four adipose-clipped fish were captured.

Tigger lake was sampled December 20, 1979, and 19 unmarked and 72 adipose-clipped fish were recovered from minnow traps. Chi-square analysis of minnow trap catches revealed a significant difference, at the 95% confidence level, between the catches of unmarked and adipose-clipped trout.

Weiner Lake was sampled October 22, 1979 and December 26, 1979, and minnow trap catches were two adipose-clipped trout and one adipose-clipped trout, respectively.

Florence Lake was sampled December 28, 1979 and no fish were captured.

Growth of Swanson Strain Rainbow Trout

Data collected from gill net catches in a wide range of lake types showing growth of Swanson strain rainbow trout in stocked Matanuska-Susitna Valley lakes are presented in Table 13. The wide range of mean lengths and weights of Age I trout are primarily caused by variable sampling dates, differences in stocking densities and survivals, and a wide ranging MEI.

Mean lengths for 1978 Swanson strain rainbow trout captured in gill nets, fyke nets and minnow traps during habitat studies and populations sampling in Johnson Lake during 1979 are presented in Figure 3.

Miscellaneous Findings

Gill Net and Fyke Net Sampling Biases:

Data collected by fyke and gill nets for five Matanuska-Susitna Valley lakes are presented in Table 14. In each lake, all fish captured by fyke

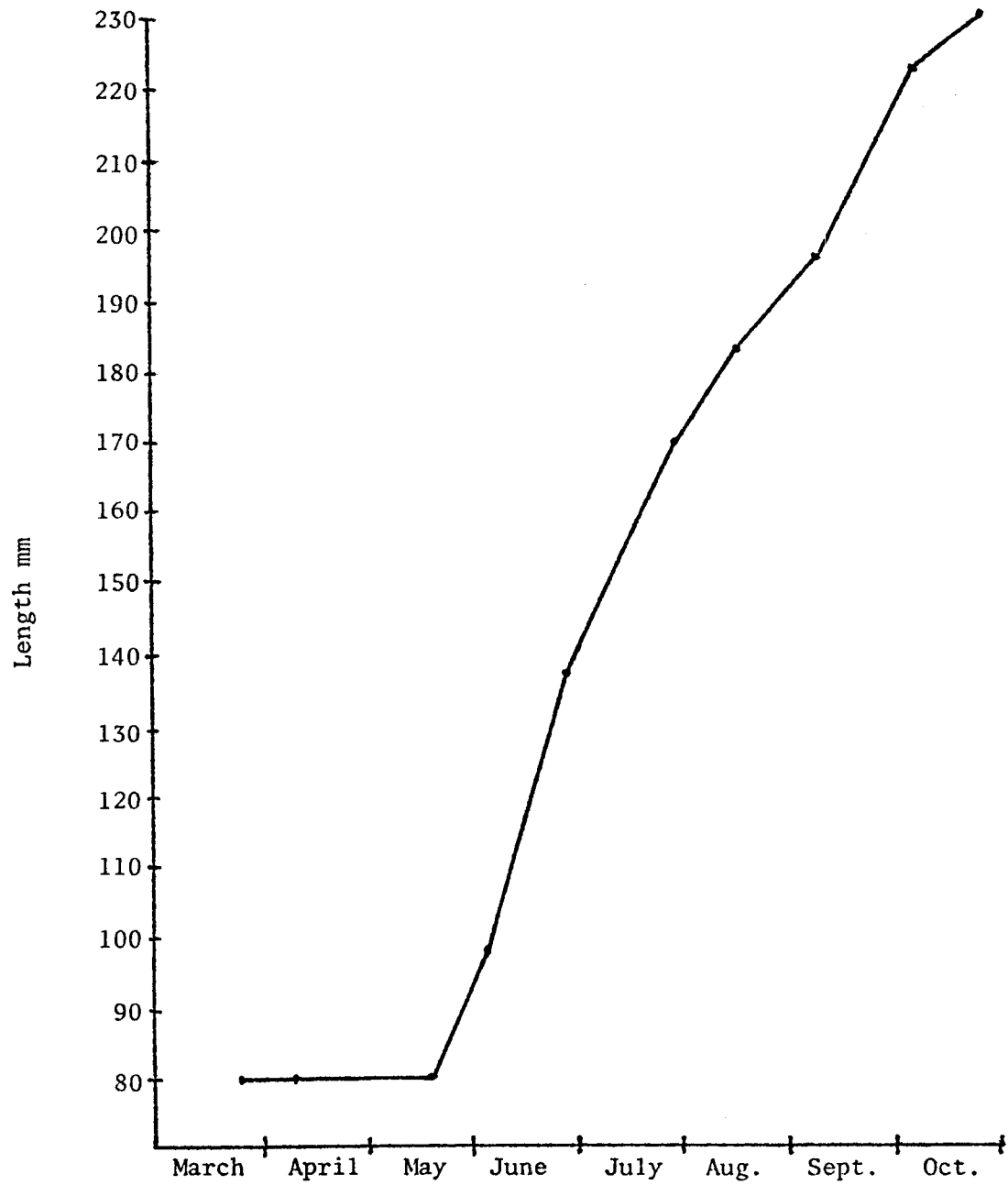


Figure 3. Growth Curve for Swanson Strain Rainbow Trout Caught by Fyke Nets, Gill Nets and Minnow Traps in Johnson Lake, 1979.

Table 12. Stocking Summary for Selected Matanuska-Susitna Valley Lakes, 1979.

Lake	Surface Area (Acres)	Littoral* Acre (Acres)	Strain**	Mark***	Date Stocked	Number Stocked	Stocking Size (Fish/lb)	Stocking Density	
								(Fish/ Surface Acre)	(Fish/ Littoral Acre)
Johnson	40.3	18.5	S	NM	8/14/79	3,980	970	193	421
			S	AD	9/10/79	3,800	362		
Irene	18.0	6.7	S	NM	8/14/79	1,790	970	206	554
			S	AD	9/7/79	1,920	349		
Florence	54.6	28.9	S	NM	8/13/79	5,300	970	205	388
			S	AD	9/7/79	5,900	349		
Reed	19.5	13.7	S	NM	8/12/79	1,995	970	212	302
			S	AD	9/7/79	2,145	349		
Tigger****	23.0	....	S	NM	8/13/79	2,200	980	203	....
			S	AD	9/7/79	2,477	349		
Weiner	27.0	....	S	NM	8/14/79	2,690	970	189	....
			S	AD	9/10/79	2,425	362		

* Littoral area is that portion of the lake less than 15 ft deep

** Strain: S = Swanson

*** Mark: AD = adipose finclip NM = unmarked

**** Tigger Lake contains stickleback populations

Table 13. Mean Length and Weight Data Compiled from Gill Net Catches for Swanson Strain Rainbow Trout in Stocked Lakes of the Matanuska-Susitna Valleys, 1975-1979.

Non-Stickleback Lakes	MEI	Age 0 Year Planted	Fall Age I		Spring Age II		Fall Age II		Fall Age III	
			Mean Length (mm)	Mean Weight (gm)	Mean Length (mm)	Mean Weight (gm)	Mean Length (mm)	Mean Weight (gm)	Mean Length (mm)	Mean Weight (gm)
Reed	4.9	1974	180	61	233	141	295	288	400	656
Marion	0.4	1976 1978	153 180	39 63	215	108	270	208	356	549
Irene	10.4	1976 1978	193 251	82 186	269	223	...	...	510	1,390
Ravine	20	1976 1978	209 234	113 155	276	245	...	...	500	1,424
Florence	7.6	1977	195	90	249	173	286	262		
Canoe	18.1	1975	304	421	...	...	520	1,957		
Kepler	11.6	1975 1978	172 210	63 119	...	...	...	...	...	...
Echo	15.9	1978	205	102						
Seymour	14.6	1978	194	92						
TOTAL COMBINED MEANS			202	107	250	183	274	228	393	689
Stickleback Lakes										
Big No Luck	1.1	1975 1978	177 179	60 65	...	...	240	137	297	239
Knik	9.1	1976 1978	156 177	53 74	...	...	...	...	398	841

Table 13 (cont.). Mean Length and Weight Data Compiled from Gill Net Catches for Swanson Strain Rainbow Trout in Stocked Lakes of the Matanuska-Susitna Valleys, 1975-1979.

Non-Stickleback Lakes	MEI	Age 0 Year Planted	Fall	Age I	Spring		Age II		Fall	Age III
			Mean Length (mm)	Mean Weight (gm)	Mean Length (mm)	Mean Weight (gm)	Mean Length (mm)	Mean Weight (gm)	Mean Length (mm)	Mean Weight (gm)
Matanuska	8.2	1976	179	72	248	176	410	938	...	...
		1978	176	74						
Long	9.4	1976	161	62	220	127	375	643	...	...
		1977	193	87	...	...	...	...	...	...
TOTAL COMBINED MEANS			177	70	229	147	320	503	352	567

Table 14. A Comparison of Fyke Net and Gill Net Catches in Five Matanuska Susitna Valley Lakes, 1978-1979.

Length Range (mm)	Percent Catch per Length Range By Gear*														
	Long Lake			Big No Luck Lake			Marion Lake			Irene Lake			Ravine Lake		
	FN	GN	GN(r)	FN	GN	GN(r)	FN	GN	GN(r)	FN	GN	GN(r)	FN	GN	GN(r)
106-135	9%	7%	8%	<1%	<1%	1%	3%	1%							
136-165	34%	8%	8%	30%	10%	5%	43%	14%	16%				2%		
166-195	39%	45%	55%	55%	79%	85%	47%	72%	74%	5%	3%	5%	6%	3%	7%
196-225	14%	25%	24%	14%	11%	8%	8%	13%	10%	12%	10%	10%	27%	31%	43%
226-255	3%	7%	4%	<1%						47%	45%	56%	49%	47%	46%
256-285	1%	5%	1%							30%	32%	27%	16%	17%	4%
286-315	<1%	3%	<1%							6%	11%	2%		2%	
TOTAL CAPTURED	1372	469	274	272	147	73	428	201	100	83	120	41	136	88	28
MEAN LENGTH (mm)	173	196	184	175	179	178	169	180	179	247	251	243	232	234	225

* FN = Fyke Nets GN = Gill Nets GN(r) = Adipose-clipped fish recaptured by gill net.

net were enumerated, fork lengths recorded, then each fish was adipose-clipped and released. Fish subsequently captured in gill nets were enumerated by fin mark and fork lengths were recorded.

Mean lengths of fyke-netted fish in Long, Big No Luck and Marion Lakes were 173 mm, 175 mm and 169 mm, respectively, while mean lengths of fish captured by gill net were 196 mm, 179 mm and 180 mm, respectively. There is not sufficient information to determine which gear type most effectively sampled the total population in each lake, but substantial differences exist between fyke net and gill net catches of smaller fish. Fyke net catches of fish within a length range of 136-165 mm in Long, Big No Luck and Marion Lakes average 36%, while gill nets caught only 11% and the recapture of adipose-clipped fish in gill nets average 10% for that length range.

These findings tend to support data presented by Engel (1972) that errors in recording growth and abundance of fish populations appear to be associated with selectivity of variable mesh nets where smaller mesh sizes have lower catch efficiencies than larger meshes. Watsjold (1975) found a lack of bias of gill nets on fish populations containing only larger fish but a definite difference in sampling efficiencies on smaller fish when using gill nets with various mesh sizes and monofilament diameters.

Sampling error in recording growth and abundance of fish populations, especially populations of stocked fish within their first year of lake residency, is possible with the Swanson strain rainbow trout as a large percentage of Age I fish could fall into the 136-165 mm length category in lakes which are of low relative productivity or contain stickleback populations. Means to compensate for this potential error should be studied whether it be by use of a statistical formula or through experimentation with various gill net mesh sizes or designs.

Comparison of Peterson and Schnabel Population Sampling Techniques:

Most population estimates in Matanuska-Susitna Valley lakes from 1969-1977 were on Age I trout. Survival from time of planting as fry or fingerling to harvestable size is most critical for Alaska's lake stocking program. Estimates were made by introducing into a fish population a selected number of marked fish directly from the hatchery and comparing the marked to unmarked ratio in subsequent gill net catches.

In 1978 and 1979, fyke nets were used to capture fish from the populations being investigated. The fish were then marked and released back into the population. Population point estimates were then determined by marked to unmarked ratios using gill nets.

The problem with using gill nets to determine final marked to unmarked ratios is that often a greater percentage of the population being studied must be taken (killed) to reduce population estimate confidence limits to a reasonable interval, fish which under other circumstances would remain to be harvested by the public. In seven estimates performed in 1978 and 1979, the percentage of populations taken by gill nets during population sampling ranged from a low of 15% to a high of 46% and averaged 29% for all lakes combined. In light of data shown on gill net mortalities, information

Table 15. Comparison Between a Peterson and a Schnabel Method of Estimating Rainbow Trout Populations in Selected Study Lakes of the Matanuska-Susitna Valleys, 1979.

Lake	Strain*	Date Stocked	Number Stocked	Modified Peterson Method**				Modified Schnabel Method***			
				Population Estimate	Survival	95% Confidence Level		Population Estimate	Survival	95% Confidence Level	
Big No Luck	S	9/6/78	2,250	538	24%	436-679	19%-30%	602	27%	475-762	21%-34%
	T	9/6/78	2,250	189	8%	121-332	5%-15%	487	22%	221-812	10%-36%
	E	9/6/78	2,250	0				0			
Irene	S	9/5/78	1,200	245	20%	184-343	15%-29%	559	47%	224-1,118	19%-93%
	T	9/5/78	1,200	94	8%	51-220	4%-18%	152	13%	31-158	3%-13%
	E	9/5/78	1,200	9	1%			0			
Marion	S	9/11/78	4,560	916	20%	762-1,121	17%-25%	974	22%	803-1,181	18%-26%
	T	9/11/78	3,825	324	8%	203-608	5%-16%	212	6%	121-363	3%-10%
	E	9/11/78	4,335	0				0			
Ravine	S	9/5/78	800	435	54%	312-642	39%-80%	478	60%	319-701	40%-88%
	T	9/5/78	800	212	27%	98-425	12%-53%	319	40%	120-479	15%-60%
	E	9/5/78	800	25	3%			0			
Johnson****	S	9/7/78	4,000	919	23%	711-1,192	18%-30%	1,130	28%	1,003-1,299	25%-32%
	T	9/7/78	4,000	398	10%	209-750	5%-19%	388	10%	279-590	7%-15%
	E	9/7/78	4,000	35	1%			0			

* Strain: S = Swanson T = Talarik E = Ennis

** Estimates for Ennis fish in Irene, Ravine and Johnson Lakes are based on comparative gill net catches.

*** Wide confidence intervals for modified Schnabel method estimates and survivals are a result of too few fish being initially captured or marked fish being subsequently recaptured. Each estimate was completed within a 5-day period in Big No Luck, Irene, Marion or Ravine Lakes.

**** Johnson Lake population estimates were conducted over a 3-month period from August-October 1979. Estimates shown should be regarded as minimal.

Table 16. A Comparison of Fyke Net and Minnow Trap Catches in Johnson and Irene Lakes, 1979.

Lake	Gear* Type	Trout** Captured	Number Captured	Mean Length (mm)	Length Range (mm)	Total Catch By Gear	Mean Length (mm) by Gear	Length Range (mm) by Gear
Johnson	FN	NM	78	81	66-92	133	77	62-92
		AD	55	72	62-80			
	MT	NM	56	78	66-94	140	69	50-94
		AD	<u>84</u>	<u>62</u>	<u>50-76</u>			
	<u>TOTAL</u>	NM	134	80	66-94			
		AD	139	66	50-80			
Irene	FN	NM	139	85	68-102	229	80	58-102
		AD	90	73	58-87			
	MT	NM	15	78	63-93	72	69	55-93
		AD	<u>57</u>	<u>67</u>	<u>55-85</u>			
	<u>TOTAL</u>	NM	154	85	63-102			
		AD	147	71	55-87			

* Gear type: FN = fyke net MT = minnow trap

** Trout captured: NM = no mark (stocked 8/14/79) AD = adipose clip (stocked 9/10/79)

gathered during past population estimates were examined to see if a modified Schnabel technique for multiple census estimate of population size using only non-lethal capture methods such as minnow traps, seines or fyke nets would be feasible. A comparison between the results of Peterson and Schnabel techniques, as shown in Table 15, indicates in circumstances where at least 25% (with a minimum of 5) of the fish caught by fyke nets, marked and released, can be subsequently recaptured in the fyke nets, the Schnabel technique would be preferable to a Peterson estimate using gill nets as the final sampling method. It must be noted, however, that fyke nets, at least in Matanuska-Susitna Valley lakes, seem to be effective and non-lethal only at times of the year when water temperatures are near or below 10°C (50°F) and lake conditions are such that the fish move through the shoal areas of the lake. More work must be done using fyke and gill nets on several age classes of fish in various lakes before advantages and limitations can be accurately defined.

Minnow Trap and Fyke Net Sampling Biases:

Preliminary investigations concerning the survival of two size groups of Swanson strain rainbow trout fingerlings, stocked in August and September 1979, were conducted in Johnson and Irene Lakes in October 1979 before ice had formed. In each lake, fyke nets and minnow traps were fished consecutively during a 24-hour period. Fyke nets (described in techniques section) had a square mesh size of 9.5 mm (.375 in) while minnow trap mesh size was 3.2 mm (.125 in). Catches for each gear type are presented in Table 16.

It had been assumed that minnow traps would effectively sample all size ranges of the newly stocked fingerlings and did, in fact, capture fish in a range of lengths comparable to those captured in fyke nets. But a comparison between fyke net and minnow trap catches reveal the mean length for fyke net catches exceeded the mean length of minnow trap catches in each lake by over 8 mm. If a population estimate had been attempted, the use of either 9.5 mm mesh fyke nets or minnow traps as a single sampling device might have led to erroneous conclusions regarding both mean lengths and survivals. Fyke nets with the large mesh size of 9.5 mm probably let small fish escape through the mesh while larger fingerlings would not enter minnow traps as readily as smaller fish.

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